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BOTTOMLAND HARDWOODS RESPOND TO CUTTING

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CENTRAL STATES FOREST EXPERIMENT STATION

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Central States Forest Experiment Station, U. S. Dept. of Agriculture
Forest Service, 111 Old Federal Building, Columbus 15, Ohio
W. G. McGinnies, Director

Technical Paper 154
July 1958

Dr. Leon S. Minckler is a veteran of more than 20 years in forest research. His Forest Service career began shortly after receiving his doctorate in plant physiology from New York State College of Forestry at Syracuse. He worked with both the Lake States and the Southeastern Forest Experiment Stations before transferring to the Central States Station in 1946. Minckler is project leader in silviculture and forest management at the Carbondale Forest Research Center in southern Illinois. He has authored about 75 technical publications. Recently he returned from a teaching assignment at the University of Michigan where he filled in during the absence of the professor of silviculture.

Dr. Minckler is married, has seven children, and lives on a farm near Carbondale, Illinois.

BOTTOMLAND HARDWOODS RESPOND TO CUTTING

Leon S. Minckler, forester

Bottomland hardwoods in the upper Mississippi and lower Ohio River valleys grow very fast and could produce high yields of good timber in a short time. Although Putnam[1] and others have studied bottomland hardwoods in the lower Mississippi Valley, until recently little was known about the management of this type in the more northern region. Cutting-practice studies now underway, however, have begun to fill in some of the gaps. For example, tests in a typical bottomland stand in southwestern Illinois suggest that the best way to start to manage such a stand is to make a heavy improvement and harvest treatment--cut the merchantable trees not suitable for growing stock and kill the culls. On the study area, this created large openings where reproduction grew rapidly and the net board-foot growth of the remaining trees was about equal to that of the heavily stocked untreated stands.

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[1] Putnam, John A. Management of bottomland hardwoods. South. Forest Expt. Sta. Occas. Paper 116, 60 pp. 1951.

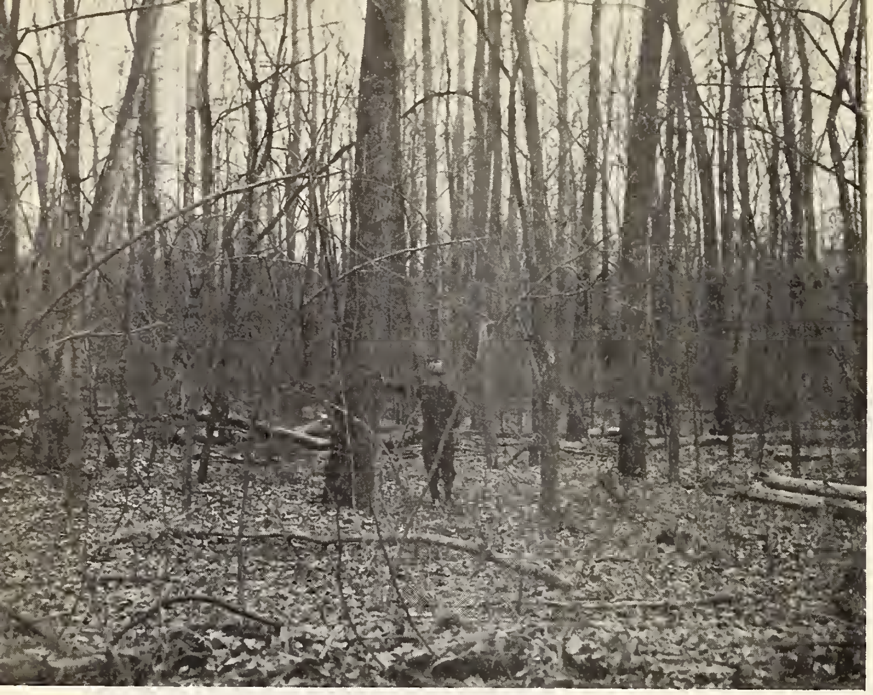

Figure 1.--Cottonwood stand containing nearly 17,000 board-feet (International 1/4-inch scale) per acre.

WHAT WE DID

The Bottomland Test Area

Study plots were established in southwestern Illinois on the Mississippi flood plain. The site is flat and well drained. The soil is a deep silt-loam that produces cottonwood trees 100 feet or more in height in 30 to 35 years (fig. 1). Although temporary flooding for a few days or more is common this occurred rarely during the period of the study.

Description of Stands Studied

The timber stands in the study area averaged 10,000 board-feet (International 1/4-inch scale) per acre in sawtimber trees (merchantable trees 10.6 inches d.b.h. and larger). The average acre supported 87 pole-sized and 59 sawtimber-sized trees, which had a combined basal area of 115 square feet.

Generally, the stands were uneven-aged, although rather large patches of even-aged eastern cottonwood[2] and silver maple occurred. Two or three light cuts, mostly for ash handle bolts, had been made during the previous 15 to 20 years but no stand improvement work had been done.

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[2] All common species names are given according to Little, Elbert L. Jr., Check List of Native and Naturalized Trees of the United States, U. S. Dept. Agr. Handbook No. 41.

Silver maple, eastern cottonwood, green ash, and American elm made up about 4/5 of the sawtimber-sized trees. Cottonwood was generally lacking among the pole sizes but boxelder was plentiful. There were nearly three times as many silver maple as any other species. Minor species included hackberry, American sycamore, pecan, pin oak, and other oaks.

Treatments Made

Four different treatments were made on three blocks of four 2-acre square plots, as follows:

Treatment	Trees cut per acre		Cull trees treated by girdling or poisoning		Total basal area removed or treated
	Description	Gross volume[3]	Description	Basal area	
		Bd.-ft		Percent	Percent
Clear cut	All merchantable trees	9,300	All other trees 4.6 inches and larger	36	100
Heavy improvement and harvest cut	All non-growing stock merchantable trees	5,700	All culls and non-growing stock pole-sized trees	31	63
Light improvement cut	Poorest risk, non-growing stock merchantable trees	500	All culls and non-growing stock pole-sized trees	33	36
No cutting	None	0	None	0	0

[3] Log cull due to defect was 9.0 percent on the partially cut plots and 6.4 percent on the clear-cut plots. On partially cut plots 54 percent of cut volume was in grade 1 and 2 logs and on clear-cut plots the percentage was 61. (Forest Products Laboratory log grades.)

This provided three replications of each treatment that were randomized within blocks. Isolation strips 1 chain wide were left between plots and 2 chains wide between blocks.

WHAT WE FOUND OUT

Growth After Cutting

The combined heavy improvement and harvest cut gave the best over all growth results. The net board-foot volume growth during the 3 years after cutting was about the same for all cutting treatments but net basal area growth was much greater on the heavily improved plots (table 1 and fig. 2). Mortality, on the other hand, was several times greater on the check plots.

Net sawtimber volume growth in board-feet was related to tree-size distribution (table 2). Plots with a high percentage of the basal area in trees 11 to 17 inches in diameter had greater volume growth than plots with a high percentage of the residual stand in trees larger than this. The above results show that the residual thrifty trees, after release from competition, definitely increase in diameter growth and that heavy improvement cutting practically eliminates mortality.

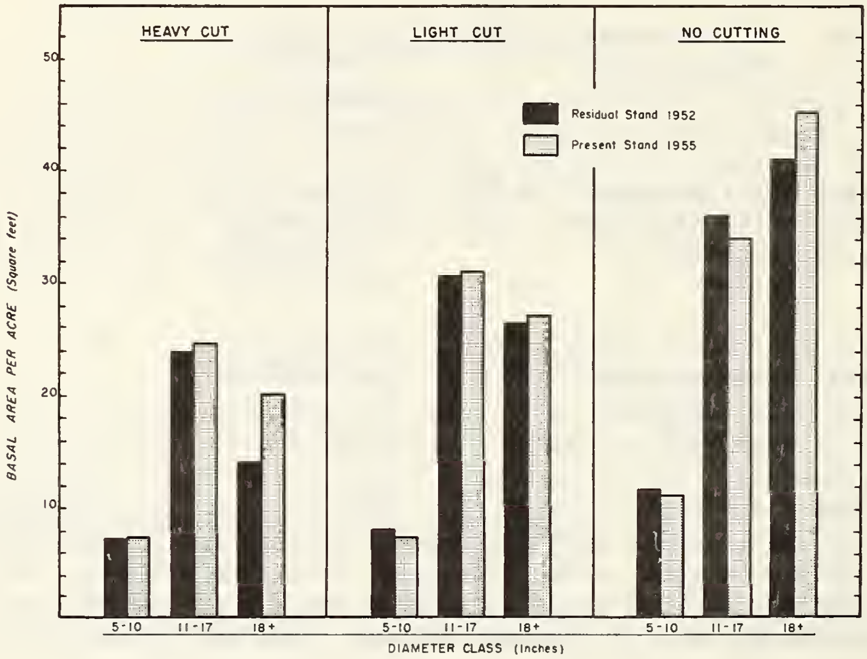

Figure 2.--Basal area growth by cutting intensity and diameter distribution.

Table 1.--Growth and mortality per acre by intensity of improvement cutting[1]

Cutting intensity	Residual stands 1952		3-Year net growth		Dead trees basal area
	Volume	Basal area	Volume	Basal area	
	Bd.-ft. Int.	Sq. ft.	Bd.-ft. Int.	Sq. ft.	Sq. ft.
Heavy	5,220	44.9	1,770	7.2	0.7
Light	7,070	65.5	1,690	.6	3.8
None	10,570	89.3	1,720	1.9	8.1

[1] Each value is the mean of three 2-acre plots. All values are exclusive of cull trees. The clear-cut plots are not included because no measurable volume growth occurred in 3 years.

Table 2.--Sawtimber volume growth per acre as related to basal area and diameter distribution of the residual stand by intensity of improvement cutting

Cutting intensity	Residual stand basal area[1]	Percentage of basal area in 11- to 17-inch class	3-Year net volume growth
	Sq. ft.	Percent	Bd. -ft.
Heavy	45	66	2,186
	50	55	1,473
	39	37	1,656
Light	67	62	3,079
	70	42	1,269
	59	36	716
None	105	49	2,755
	68	37	1,287
	95	34	1,114

[1] Exclusive of cull trees.

Lessons in Stand Improvement

Although most of the girdled stems died, nearly all of the girdled boxelder, silver maple, and ash up to 14 inches in diameter were sprouting vigorously 3 years later (fig. 3). The pole-sized trees of other species also sprouted but to a lesser extent. After only 3 years, many of the sprouts were 10 to 15 feet in height. In addition, about 20 cull trees per acre (mostly boxelder) had grown into the 5-inch class during this period. Many of these were the smaller stems of sprout clumps remaining after the larger stems were girdled. Trees poisoned with 2,4,5-T in frills did not sprout.

It is clear that girdling cull trees in bottomland stands is not an effective way to kill them, especially trees up to 16 inches d.b.h. Instead, such unwanted trees should be poisoned,

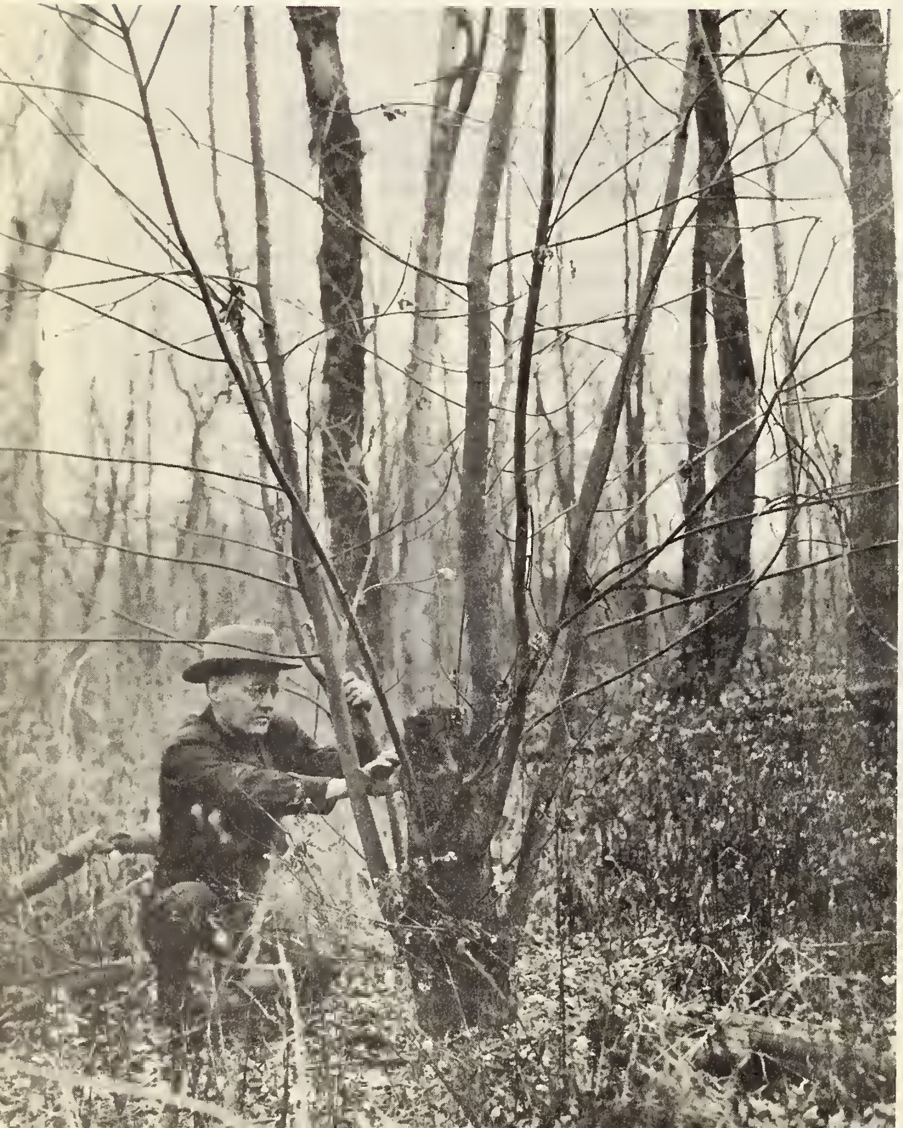

Figure 3.--A sprouted stump of silver maple 4 years after girdling. The original tree has broken off, but 6 tall, vigorous sprouts have grown from the stump. This cull tree should have been killed by poison.

even trees as small as 1 inch in diameter if they will interfere with desirable reproduction. All members of undesirable sprout clumps should be poisoned regardless of size.

Another lesson learned during stand improvement work concerned the development of sprouts on the boles of silver maple trees exposed to sun by cutting (fig. 4). About one-third of the maples on the plots developed sprouts on the trunk. All of these were exposed trees but some trees, equally exposed, did not sprout. These were usually the better and more vigorous trees. Green ash and cottonwood did not sprout along the trunk regardless of exposure. Apparently only vigorous silver maple trees with boles free of bumps and sprouts should be left in exposed positions after cutting. If possible, this species should be left in clumps to avoid extreme exposure of stems.

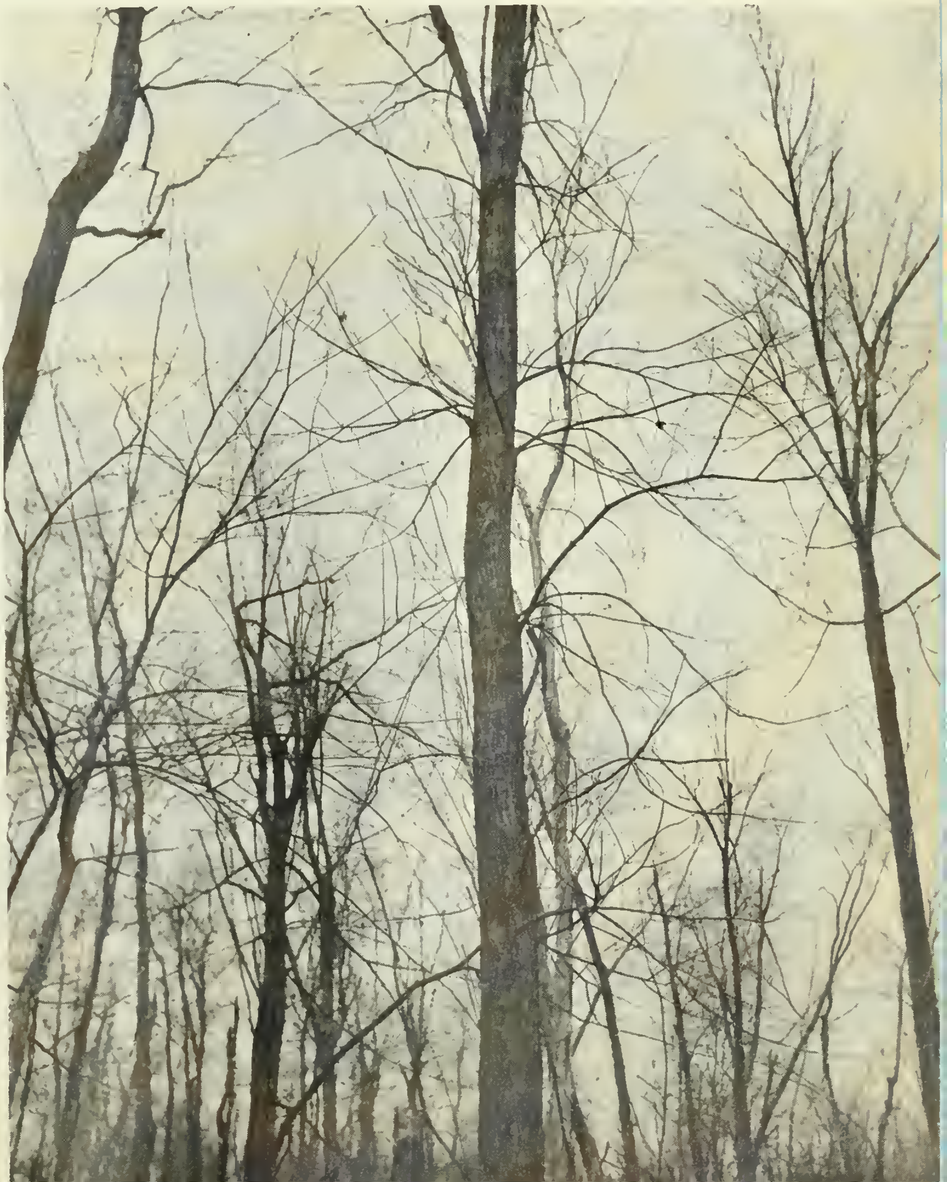

Figure 4.--Growth of branches on the bole of an exposed silver maple tree. These branches are mostly from old, partly overgrown knots on the trunk. They do not form new defects but prevent the future production of clear wood. Trees of this species should not be exposed to full sunlight along the trunk.

Reproduction After Cutting

Originally the cut plots averaged about 2,570 seedlings (trees less than 0.6 inches d.b.h.) and 180 saplings (trees 0.6 to 4.6 inches d.b.h.) per acre (tables 3 and 4). After 3 years the seedlings in the cut stands were reduced to about 40 percent of their original number but all saplings had increased by 7-fold and saplings of desirable species by 10-fold (fig. 5). All of the cut stands showed a large increase in number of saplings during the 3 years after cutting (fig. 6). Obviously many of the seedlings grew into saplings and others died and the seedling class was not replenished by new reproduction. There were, however, about 3,500 silver maple seedlings per acre that originated from the current (1956) seed crop which are not included in the above data.

Table 3.--Number of seedlings[1] per acre in 1953 and 1956 by species and cutting intensity

Species	Clear cut		Heavy		Light		None	
	1953	1956	1953	1956	1953	1956	1953	1956
Desirable species								
Green ash	1,070	280	1,130	780	1,450	520	160	170
Silver maple[2]	740	140	1,230	410	1,140	270	560	60
Eastern Cottonwood	280	10	10	0	160	30	330	0
Miscellaneous	0	30	0	40	60	70	20	30
Totals	2,090	460	2,370	1,230	2,810	890	1,070	260
Undesirable species								
Elm and hackberry	80	60	0	100	40	100	0	60
Boxelder	270	80	10	170	10	10	20	110
Totals	350	140	10	270	50	110	20	170

[1] Trees less than 0.6 inches d.b.h. Values given are means of 3 plots.

[2] The table values are exclusive of about 3,500 silver maple current year's (1956) seedlings per acre. These seedlings were 1 to 2 months old in June 1956.

Table 4.--Increase in number of saplings[1] per acre between 1953 and 1956 by species and cutting intensity

Species	Clear cut		Heavy		Light		None	
	1953	1956	1953	1956	1953	1956	1953	1956
Desirable species								
Green ash	70	900	100	720	80	1,080	160	250
Silver maple	0	180	0	110	80	70	20	30
Eastern cottonwood	0	80	0	0	0	40	0	30
Miscellaneous	0	140	0	70	0	10	0	10
Totals	70	1,300	100	900	160	1,200	180	320
Undesirable species								
Elm and hackberry	10	10	10	0	30	60	20	20
Boxelder	10	100	60	90	90	10	170	130
Totals	20	110	70	90	120	70	190	150

[1] Trees 0.6 to 4.6 inches d.b.h. Values given are means of 3 plots.

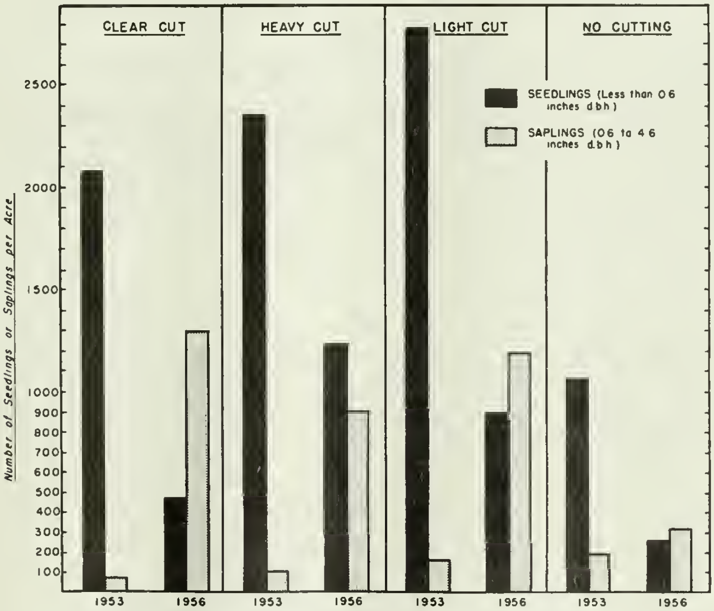

Figure 5.--Amount of desirable tree reproduction by cutting intensity and size.

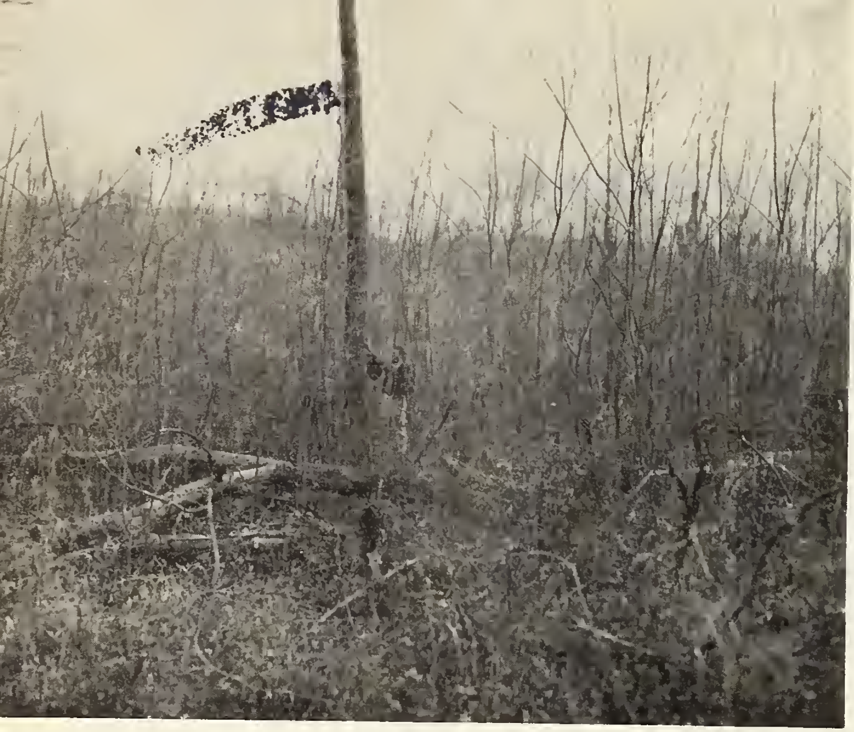

Figure 6.--Sapling-sized reproduction 4 years after clear cutting. This is mostly ash and silver maple which has developed from advanced reproduction on the ground at the time of cutting.

The uncut stands produced very few saplings and new seedlings. Three years after cutting there were no real differences between the heavy and light improvement cuts; both had about 1,000 seedlings and 1,000 saplings per acre of desirable species, exclusive of the 3,500 current year's silver maple seedlings.

Reproduction 3 years after cutting was composed chiefly of desirable species. On the cut plots 77 percent of the seedlings and 84 percent of the saplings were ash and silver maple. In general, there were about twice as many ash as maple seedlings and 7 times more ash than maple saplings. Apparently more ash than maple seedlings grew into the sapling class during the 3-year period.

The increased light that resulted from heavy cutting caused rapid growth of seedlings to saplings. This did not occur on uncut stands. Unless overtopped by weed species and sprouts from girdled culls, these saplings will normally fill up the openings and some of them will eventually develop into crop trees. However, the lack of normal rainfall and flooding during the 3-year period of this study probably greatly decreased reproduction of cottonwood and silver maple. Cottonwood reproduction was restricted mostly to scattered patches in small ground depressions in the forest floor.

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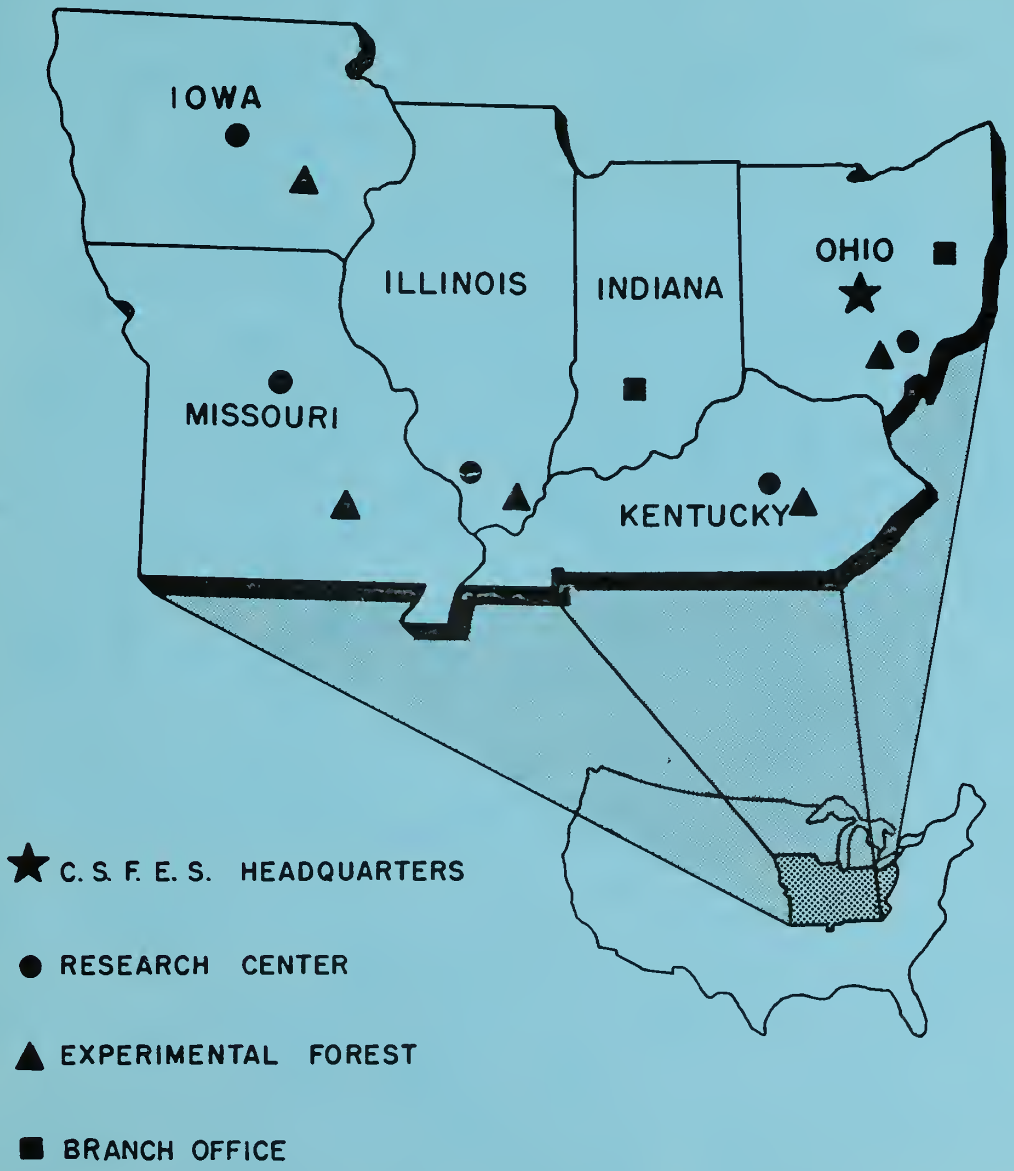

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